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CONDUCTIVITY AND VISCOSITY
of
SOLUTIONS OF RUBIDIUM SALTS IN MIXTURES
of
ACETONE AND WATER.

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DISSERTATION

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Submitted to the Board of University Studies of
the Johns Hopkins University in conformity
with the requirementss for the degree of
Doctor of Philosophy

by

HORATIO HUGHES.

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CONDUCTIVITY AND VISCOSITY OF SOLUTIONS OF RUBIDIUM SALTS IN MIXTURES OF ACETONE AND WATER.

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Introduction.

During the past twelve years work has been in progress continuously in this laboratory on the conductivity and viscosity of solutions of salts in pure and mixed solvents in connection with the nature of solution. A number of papers on this subject have already been published.

Jones and Lindsay[1] explained the minima in the conductivity curves in mixtures of alcohol and water as due to each associated solvent breaking down the association of the other associated solvent.

Jones and Murray[2] showed experimentally that when one associated solvent in mixed with another associated solvent, each diminishes the association of the other.

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[1] Zeitsch. f. physik. Chem. 56, 129 (1906). Amer. Chem. Journ., 28, 329 (1902).

[2] Amer. Chem. Journ. 30, 139 (1903).

Jones and Carroll[1] showed that the change in viscosity when alcohol and water are mixed must be taken into account in dealing with the conductivities in mixtures of such solvents.

Jones and Bassett[2] studied the ionic velocities of the ions of silver nitrate in pure and mixed solvents.

Jones and Bingham[3] not only measured conductivities in but viscosities of mixed solvents and of solutions in them.

Jones and Rouiller[4] studied the migration velocities of the ions of silver nitrate in mixtures of acetone and methyl alcohol, using the migration velocity apparatus designed by Jones.[5]

Jones and McMaster[6] found maxima in the conductivity curves in mixtures of acetone and the alcohols. These they explain in terms of the solvate theory of solution prepared by Jones. They also found negative temperature coefficients of conductivity for cobalt chloride in a certain mixture of acetone and ethyl alcohol, these were explained.

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[1] Zeitsch. f. physik. Chem., 56, 150 (1906); Amer. Chem. Journ., 32, 521 (1904).

[2] Amer. Chem. Journ., 32, 409 (1904).

[3] Ibid, 34, 481 (1905). Zeitsch. f. physik. Chem., 57, 193, (1906).

[4] Amer. Chem. Journ., 36, 427 (1906).

[5] Ibid, 32, 409 (1904).

[6] Ibid, 36, 325 (1906). Zeitsch. f. physik. Chem., 57, 257, (1906).

Jones and Veazey[1] obtained some of the most interesting results in the early stages of this work. When alcohol and water are mixed there is a marked increase in viscosity. This was shown to be due to each associated solvent breaking down the association of the other, a larger number of smaller particles exerting greater friction when moving over one another, than a smaller number of larger particles. This explanation is in keeping with the fact that the most strongly associated liquids show,on mixing, the greatest increase in viscosity.

Jones and Veazey also explained the fact that certain salts lower the viscosity of water. These are salts of potassium, rubidium and caesium.

These elements have the largest atomic volumes; their atomic volumes being much greater than the molecular volume of water. When these large ions are mixed with water they diminish the frictional surfaces in contact with one another, and, consequently,the viscosity which measures the friction of the molecules as they move over one another. The effect of a dissolved salt on the viscosity of water was shown to be dependent on the atomic volumes of its constituents, and this was shown to hold throughout the entire Periodic System.

The investigations of Jones and his co-workers, thus far referred to, have been published by the Carnegie Institution of Washington as monograph No. 80.

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[1] Amer. Chem. Journ., 37, 405 (1907); Zeitsch. f. physik. Chem., 57, 193 (1907); 62, 44 (1908).

Jones and Mahin[1] studied the conductivities and viscosities of solutions of tetraethylammonium iodide in pure and mixed solvents. They also studied the conductivities and viscosities of solutions of lithium nitrate in ternary mixtures of certain solvents.

Jones and Kreider[2] measured the dissociation of certain electrolytes in the alcohols by the conductivity method. They found the following relation

$$\frac{\mu_\infty \text{ in Methyl alcohol}}{\mu_\infty \text{ in Ethyl alcohol}} = \text{Constant.}$$

The value of this constant for binary electrolytes is 2.37; for ternary electrolytes is 3.68.

In their later work they show that the above relation holds for salts that are solvated to approximately the same extent.

Schmidt and Jones[3] extended these investigations to glycerol as a solvent. The object was to work with a solvent with very large viscosity and see what relations would manifest themselves. The temperature coefficients of conductivity in glycerol as the solvent, were found to be enormous.

Guy and Jones[4] extended the work of Schmidt and Jones

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1. Zeitsch. f. physik. Chem., 62, 44 (1908); Amer. Chem. Journ., 41, 433 (1909).

2. Ibid, 45, 282 (1911); 46, 574 (1911).

3. Amer. Chem. Journ., 42, 37 (1909).

4. Ibid, 46, 131 (1911).

in glycerol as the solvent; working from 25° to 75°. They also worked in mixtures of glycerol with water and the alcohols. Those salts which, in general, have the greatest solvating power, have the largest temperature coefficients of conductivity in glycerol; and these are greater in the more dilute solutions. This is strictly analogous to what has been pointed out for aqueous solutions, by Jones[1], from the work of Jones and West.[2]

Probably the most important point established by the work of Guy and Jones is that while most salts raise the viscosity of glycerol, salts of rubidium and ammonium lower the viscosity of glycerol. This is exactly analogous to what was found for aqueous solutions. Here, salts of potassium, rubidium and caesium lowered the viscosity of water, and the explanation offered by Jones and Veazey has already been referred to. The same explanation holds in glycerol as the solvent.

Davis and Jones[3] extended the work still farther in glycerol as a solvent. They studied especially the conductivities and viscosities of glycerol solutions of ammonium and rubidium salts. Salts of rubidium lower very greatly the vis-

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[1] Amer. Chem. Journ., 35, 445 (1906).

[2] Ibid, 34, 357 (1905).

[3] Zeitsch. f. physik. Chem., (1912).

cosity of glycerol, ammonium salts lower the viscosity of this solvent much less than salts of rubidium. The lowering of the viscosity is less the higher the temperature and the greater the dilution. These facts are all in keeping with the theory of Jones and Veazey to account for such phenomena.

The work of Jones with Mahin, Kreider, Schmidt, Guy and Davis, also with Stine[1] and Pearce[2] is now in press as a whole, and will soon be published as monograph No.180 by the Carnegie Institution of Washington.

The work in nonaqueous and mixed solvents, especially including acetone and formamide, is now in progress in this laboratory. We expect to continue such work for many years to come, studying a much larger number of nonaqueous solvents, and a much larger number of substances dissolved in them.

EXPERIMENTAL.

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All previous work in this laboratory with acetone as a solvent shows that it has exceptional properties. Measurements of both conductivity and fluidity have usually given results that are, in terms of other solvents, abnormal. For this reason it was chosen as a solvent in the present inves-

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[1] Amer. Chem. Journ., 39, 313 (1908).

[2] Ibid, 38, 683 (1907).

tigation. It was hoped that with such a solvent, the property possessed by rubidium salts of forming solutions having lower viscosity than that of the pure solvent might throw some additional light upon the phenomena presented by solution.

Only mixtures of acetone and water have been used, because in pure acetone the rubidium salts studied are not sufficiently soluble to affect the fluidity to a measurable extent.

Conductivity Apparatus.

Bridge:- The conductivity measurements were made by means of a slide wire bridge which is about five meters long; the balance being detected by a telephone receiver. The bridge and rheostat were made and standardized by Leeds, Northrup and Company of Philadelphia, Pa.; and the rheostat was compared with one which had been recently standardized by the United States Bureau of Standards.

A double system of wiring was used between the rheostat slide wire and cells, so that by means of a double arm double throw switch the arms of the bridge could be interchanged. In this way the resistance a of the first portion of the slide wire was read and then b (= 1000 - a) for comparison. The circuit was opened and closed by an ordinary telegraph key whose resistance was made of negligible quantity by connecting the frame to the lever by a short spring of large copper wire.

The wire used throughout was number 12 gauge and the cells containing the solutions were connected with the rest

of the bridge by a large flexible cable of copper having a negligible resistance. All connections were soldered, and the various portions of the apparatus were tested for any appreciable resistance. The two halves of the double system for reading a and b were carefully compared, and b was found not to differ from 1000 - a by any appreciable quantity, except for resistances smaller than any used in this investigation--that is, below 10 ohms.

Cells:- The conductivity cells were of three forms. For the most concentrated solutions two U cells with adjustable electrodes were employed having constants of about 15,000 and 30,000. The most dilute solutions, and the solvents, were measured in cells with cylindrical electrodes of the type described by Jones and Schmidt[1], and by Jones and Kreider[2], and with constants ranging from 2.9 to 4.3. The intermediate dilutions, that is, from $\frac{N}{10}$ to $\frac{N}{400}$ solutions were measured in cells of the plate type described by Jones and Bingham.[3]

The constant temperature baths were the usual cylindrical form with double walls insulated by asbestos, heated by gas from beneath, and cooled by spiral coils of copper tubing plac-

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1. Amer. Chem. Journ., 42, 39 (1909).
2. Ibid, 45, 282 (1911).
3. Ibid, 34, 481 (1905).

ed close to the bottom.

All flasks were carefully calibrated to hold aliquot parts of the true litre at 20° and solutions were brought to within 0°.1 of this temperature before being diluted to the mark.

SOLVENTS.

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Water:- The water was purified by the method of Jones and Mackay[1] as modified by Schmidt, and had a mean specific conductivity of 1.5×10^{-6} at 25°.

Acetone:- Kahlbaum's so-called pure acetone was allowed to stand for several days over calcium chloride and distilled two or three times. No difficulty was experienced in obtaining a product of approximately the same conductivity as the water used in this work. Solutions were made up quickly as possible after distilling the acetone, which was always kept in a dark place.

Mixtures of Acetone and Water:- The mixtures used as solvents were made by diluting a given volume of acetone to a defimite volume with water at 20°. For convenience the number of cubic centimeters of acetone diluted to one hundred cubic centimeters was indicated as the "percentage" of Acetone in the solvent. A very considerable contraction takes place when acetone and water are mixed, so that the figures used to designate the mixture are of course not true percentages, either by weight or volume. The true percentage, however,

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[1] Amer. Chem. Journ., 17, 83 (1895).

is of no consequence as long as the mixtures is thus defined. Actually, the mixture of 500 c.c. acetone diluted to one litre at 20° contains about 42% by weight of acetone, and the mixture of 250 c.c. acetone diluted to one litre contains approximately 20% by weight of acetone.

Solutions.

Solutions of one-tenth normal and all greater concentrations were made by dissolving the requisite weight of salt. The $\frac{N}{50}$ and $\frac{N}{100}$ solutions were made from the $\frac{N}{10}$ by dilution; and the $\frac{N}{200}$ and $\frac{N}{400}$, respectively, were made from these. The $\frac{N}{800}$ and $\frac{N}{1600}$ concentrations were prepared, respectively, in the same manner from the $\frac{N}{200}$ and $\frac{N}{400}$. The last two concentrations were thus made in three dilutions from the $\frac{N}{10}$ concentration. Upon the basis of a probable percentage deviation of 0.10% in the original weight of salt and in the measurement of the solvent in the flask, and of 0.40% in the measurements from the burette, the probable error in the value of V in these greatest dilutions is about 0.70%. The probable error in the other dilutions is of course much less than this; being within 0.14% in the case of the $\frac{N}{10}$ and all greater concentrations.

All solutions were made up at 20°.

No correction for changed normality at higher temperatures has been applied to the values obtained for molecular conductivity.

Rise in temperature of course diminishes the normality of a solution. This effect is accompanied by an increase in

molecular conductivity which is complex. While this increase in conductivity due to temperature is of the same order of magnitude as that produced by the same lowering of normality caused by diluting with more of the solvent, the two effects bear no known relation to each other.

Salts.

The rubidium salts used in this work were Kahlbaum's purest products. They were recrystallized two or three times from conductivity water, precipitated and washed with alcohol and dried at 120° to 135° according to the nature of the salt. The iodide was pure white after drying, and the more concentrated solutions were only slightly coloured after standing several days.

PROCEDURE.

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Conductivity Measurements.

The values of the molecular conductivity μ_v are computed from the relation $\mu_v = \frac{K v a}{w b}$

where V is the number of litres of solvent which contains a gram-molecular weight of the salt; w, the resistance in ohms; $\frac{a}{b}$, the ratio from the Wheatstone bridge; and K, the cell constant.

The cell constants were determined with solutions of potassium chloride of $\frac{N}{50}$, $\frac{N}{500}$ and $\frac{N}{200}$ concentrations. The value taken for the molecular conductivity of the $\frac{N}{50}$ solution

was that given by Ostwald, namely, 129.7 reciprocal Siemens units at 25°. Three resistances were used in the measurement of each solution.

It should be pointed out that the fact that w is measured in ohms is not incongruous with the use of reciprocal Siemen's units in the result, the factor $\frac{1}{1.063}$ being included in the cell constants obtained. To convert the results given in the tables to reciprocal ohms, it is only necessary to multiply by 1.063.

The calculation of data was facilitated by the use of tables of values of $\frac{a}{b} \times \frac{1}{w}$. By use of notation by powers of 10, twenty values of $\frac{1}{w}$ were sufficient for the preparation of these tables, which were readily computed with a calculating machine. Not only does the use of such tables save considerable time in computation, but in their preparation, the chances of mistakes are eliminated by methods which do not obtain when the values are independently computed. The tables used in this work gave all Wheatstone bridge ratios from $\frac{400}{600}$ to $\frac{600}{400}$ by millimeters with interpola to tenths of millimeters.

Temperature Coefficients.

The temperature coefficient in conductivity units is the increase in conductivity for each degree rise in temperature, that is:

$$\text{Temperature coefficients} = \frac{\mu_{t_2} - \mu_{t_1}}{t_2 - t_1}$$

The temperatures compared being always 10° apart. The temper-

ature coefficient in percent. is the above quantity divided by the conductivity at the lower temperature, and multiplied by 100; e.g.:

$$\text{Percent Coefficients} = \frac{\mu_{35^\circ} - \mu_{25^\circ}}{10} \cdot \frac{100}{\mu_{25^\circ}}$$

TABLE I.

Molecular Conductivity

Rubidium Iodide in "75. Percent" Acetone.

V	15°	25°	35°	45°
1	36.2	43.0	50.6	57.6
4/3	37.1	44.1	52.0	59.8
2	38.8	46.4	53.8	61.5
4	42.7	51.3	59.7	68.5
10		58.0	68.2	78.7
50		67.9	80.8	93.7
100	58.7	71.8	85.7	99.5
200	60.4	74.3	87.6	102.8
400	62.5	76.3	91.2	107.3
800	64.2	78.5	94.1	119.6
1600	65.2	80.1	95.3	111.4

TABLE II.

Temperature Coefficients

Rubidium Iodide in ".75 percent" Acetone

V	15^0-25^0	Percent	25^0-35^0	Percent	35^0-45^0	Percent
1	0.681	1.88	0.751	1.75	0.709	1.40
4/3	.701	1.89	.689	1.56	.782	1.50
2	.751	1.93	.74	1.63	.73	1.36
4	.867	2.03	.84	1.67	.876	1.47
10			.93	1.61	1.045	1.53
50			1.30	1.92	1.29	1.60
100	1.375	2.37	1.39	1.93	1.38	1.61
200	1.39	2.31	1.33	1.79	1.52	1.78
400	1.38	2.21	1.49	1.95	1.61	1.77
800	1.43	2.23	1.55	1.95	1.55	1.67
1600	1.49	2.29	1.52	1.90	1.61	1.69

TABLE III.

Molecular Conductivity

Rubidium Iodide in "62.5 per cent" Acetone

V	15^0	25^0	35^0	45^0
2	42.8	53.0	63.3	74.2
10	48.6	60.7	73.3	86.7
200	57.5	72.7	89.1	106.5

TABLE IV.

Temperature Coefficients

Rubidium Iodide in "62.5 percent" Acetone

V	Cond. Units per degree 15°-25°	25°-35°	35°-45°	Percentage 15°-25°	25°-35°	35°-45°
2	1.01	1.13	1.09	2.37	2.13	1.73
10	1.23	1.26	1.34	2.52	2.08	1.82
200	1.52	1.65	1.74	2.64	2.27	1.95

TABLE V.

Molecular Conductivity

Rubidium Iodide in "50 percent" Acetone at

V	15°	25°	35°	45°
1	46.5	57.4	68.6	81.0
4/3	46.7	58.1	69.8	82.9
2	47.2	58.8	71.0	83.9
4	49.0	62.0	76.0	91.8
10	51.5	65.3	80.3	95.2
50	55.5	71.0	87.7	105.7
100	56.6	72.2	89.7	108.8
200	58.3	74.9	92.8	112.3
400	59.0	75.8	94.0	114.1
800	60.2	77.7	95.9	116.5
1600	62.5	78.8	96.9	120.5

TABLE VI.

Temperature Coefficients

Rubidium Iodide in "50. percent" Acetone

V	Cond. Units per degree 15°-25°	25°-35°	35°-45°	Percentage 15°-25°	25°-35°	35°-45°
1	1.087	1.124	1.236	2.34	1.96	1.80
4/3	0.940	1.169	1.314	2.02	2.01	1.89
2	1.16	1.22	1.29	2.45	2.08	1.82
4	1.301	1.40	1.575	2.68	2.26	2.07
10	1.379	1.502	1.49	2.68	2.33	1.86
50	1.55	1.67	1.80	2.79	2.35	2.05
100	1.56	1.75	1.91	2.76	2.42	2.13
200	1.56	1.79	1.95	2.68	2.39	2.10
400	1.68	1.82	2.01	2.85	2.40	2.14
800	1.75	1.82	2.06	2.91	2.35	2.15
1600	1.63	1.81	2.36	2.61	2.30	2.28

TABLE VII.

Molecular Conductivity

Rubidium Iodide in "37.5 percent" Acetone

V	15°	25°	35°	45°
2	53.8	67.9	82.8	98.7
10	56.2	72.7	89.4	107.1
200	63.8	82.0	101.7	123.1

TABLE VIII.

Temperature Coefficients

Rubidium Iodide in "37.5 percent" Acetone

V	Cond. Units per degree 15°-25°	25°-35°	35°-45°	Percentage 15°-25°	25°-35°	35°-45°
2	1.41	1.49	1.59	2.62	2.19	1.92
10	1.66	1.66	1.77	2.95	2.28	1.99
200	1.82	1.97	2.13	2.86	2.41	2.09

TABLE IX.

Molecular Conductivity

Rubidium Iodide in "25. percent" Acetone

V	15°	25°	35°	45°
1	62.7	77.3	92.5	108.5
4/3	63.0	77.9	94.1	110.6
2	63.0	78.9	95.7	113.8
4	63.9	80.4	98.7	117.3
10	65.1	83.2	101.8	121.6
50	70.8	90.2	111.0	133.4
100	72.0	91.7	113.1	135.9
200	74.2	94.5	117.1	139.9
400	74.0	94.1	116.8	140.1
800	75.1	95.6	118.5	145.2
1600	75.8	96.4	118.3	141.5

TABLE X.

Temperature Coefficients

Rubidium Iodide in "25. percent" Acetone

	Cond. Units per degree			Percentage		
V	15°-25°	25°-35°	35°-45°	15°-25°	25°-35°	35°-45°
1	1.45	1.52	1.61	2.32	1.97	1.74
4/3	1.49	1.62	1.65	2.36	2.09	1.75
2	1.59	1.68	1.81	2.52	2.12	1.89
4	1.65	1.84	1.85	2.58	2.28	1.88
10	1.81	1.86	1.98	2.78	2.24	1.94
50	1.94	2.08	2.24	2.74	2.31	2.01
100	1.97	2.14	2.28	2.74	2.34	2.02
200	2.03	2.26	2.28	2.74	2.39	1.95
400	2.01	2.27	2.33	2.72	2.42	2.00
800	2.05	2.29	2.67	2.73	2.40	2.25
1600	2.06	2.19	2.32	2.72	2.28	1.96

TABLE XI.

Molecular Conductivity

Rubidium Iodide in "12.5 percent" Acetone

V	15°	25°	35°	45°
2	76.2	94.2	112.5	131.6
10	80.6	100.4	121.4	144.0
200	89.9	113.4	137.7	163.1

TABLE XII.

Temperature Coefficients

Rubidium Iodide in "12.5 percent" Acetone

	Cond. Units per degree			Percentage		
V	15°-25°	25°-35°	35°-45°	15°-25°	25°-35°	35°-45°
2	1.79	1.83	1.92	2.35	1.94	1.71
10	1.98	2.09	2.36	2.43	2.01	1.86
200	2.35	2.43	2.54	2.62	2.14	1.84

TABLE XIII.

Molecular Conductivity

Rubidium Bromide in "75 percent" Acetone

V	15°	25°	35°	45°
2	28.2	33.5	38.75	43.9
4	32.5	39.1	45.74	52.6
10	39.1	47.6	55.9	64.7
50	48.7	59.6	71.0	82.8
100	52.3	64.2	76.8	89.5
200	55.1	68.1	81.6	95.1
400	58.4	71.8	85.8	100.9
800	61.2	75.7	90.8	106.7
1600	65.9	81.3	97.8	114.9

TABLE XIV.

Temperature Coefficients

Rubidium Bromide in "75 percent" Acetone

	Cond. Units			Percentage		
V	15°-25°	25°-35°	35°-45°	15°-25°	25°-35°	35°-45°
2	0.529	0.530	0.518	1.88	1.58	1.34
4	0.655	0.66	0.684	2.02	1.69	1.49
10	0.845	0.83	0.88	2.16	1.74	1.57
50	1.09	1.14	1.18	2.25	1.91	1.66
100	1.19	1.26	1.27	2.28	1.96	1.65
200	1.30	1.35	1.35	2.36	1.98	1.66
400	1.34	1.40	1.51	2.30	1.95	1.76
800	1.45	1.51	1.59	2.37	1.99	1.76
1600	1.50	1.65	1.71	2.34	2.03	1.75

TABLE XV.

Molecular Conductivity

Rubidium Bromide in "62.5 percent" Acetone

V	15°	25°	35°	45°
2	36.2	44.2	52.7	61.5
10	43.5	53.9	63.8	74.2
200	56.5	72.2	87.1	103.9

TABLE XVI.

Temperature Coefficients

Rubidium Bromide in "62.5 percent" Acetone

V	Cond. Units			Percentage		
	15°-25°	25°-35°	35°-45°	15°-25°	25°-35°	35°-45°
2	0.80	0.84	.88	2.18	1.90	1.67
10	1.04	0.99	1.04	2.39	1.84	1.63
200	1.62	1.44	1.68	2.87	1.98	1.93

TABLE XVII.

Molecular Conductivity

Rubidium Bromide in "50 percent" Acetone

V	15°	25°	35°	45°
1	40.9	50.5	60.6	71.3
2	43.3	54.2	65.7	77.8
4	45.8	57.9	70.6	84.7
10	47.8	59.8	72.5	84.8
50	54.6	69.8	86.3	103.0
100	56.6	72.4	89.9	107.9
200	57.5	73.8	91.5	110.0
400	59.3	76.1	94.5	113.3
800	60.7	78.1	97.4	117.2
1600	61.6	79.2	98.5	118.4

TABLE XVIII.

Temperature Coefficients

Rubidium Bromide in "50 percent" Acetone

	Cond. Units			Percentage		
V	15°-25°	25°-35°	35°-45°	15°-25°	25°-35°	35°-45°
1	0.956	1.01	1.07	2.34	2.01	1.76
2	1.09	1.15	1.21	2.51	2.12	1.82
4	1.21	1.27	1.41	2.64	2.19	2.00
10	1.20	1.27	1.23	2.51	2.13	1.70
50	1.52	1.65	1.67	2.78	2.37	1.94
100	1.58	1.75	1.80	2.80	2.42	2.00
200	1.63	1.77	1.85	2.84	2.40	2.02
400	1.68	1.84	1.88	2.83	2.42	1.99
800	1.74	1.93	1.98	2.87	2.47	2.03
1600	1.76	1.93	1.99	2.86	2.44	2.02

TABLE XIX.

Molecular Conductivity

Rubidium Bromide in "37.5 percent" Acetone

V	15^{0}	25^{0}	35^{0}	45^{0}
2	51.1	64.2	78.4	93.4
10	54.3	67.7	82.2	96.5
200	64.8	83.8	104.0	125.0

TABLE XX.

Temperature Coefficients

Rubidium Bromide in "37.5 percent" Acetone

	Cond. Units			Percentage		
V	$15^{0}-25^{0}$	$25^{0}-35^{0}$	$35^{0}-45^{0}$	$15^{0}-25^{0}$	$25^{0}-35^{0}$	$35^{0}-45^{0}$
2	1.31	1.42	1.50	2.55	2.22	1.92
10	1.35	1.55	1.43	2.48	2.28	1.74
200	1.91	2.02	2.10	2.94	2.41	2.02

TABLE XXI.

Molecular Conductivity

Rubidium Bromide in "25 percent" Acetone

V	15°	25°	35°	45°
2	61.2	76.6	92.6	109.7
10	63.7	79.2	95.4	111.6
50	73.3	93.8	115.4	138.4
200	75.7	96.9	119.7	143.6

TABLE XXII.

Molecular Conductivity

Rubidium Bromide in "12.5 percent" Acetone

V	15°	25°	35°	45°
2	75.6	93.1	111.5	130.3
10	81.7	102.3	123.5	146.0

TABLE XXIII.

Molecular Conductivity

Rubidium Chloride in "75 percent" Acetone

V	15°	25°	35°	45°
4	25.5	30.4	35.5	40.9
10	32.5	43.1	50.1	
200	50.8	63.1	76.0	88.0

TABLE XXIV.

Temperature Coefficients

Rubidium Chloride in "75 percent" Acetone

	Cond. Units			Percentage		
V	15°-25°	25°-35°	35°-45°	15°-25°	25°-35°	35°-45°
4	0.490	0.502	0.548	1.92	1.65	1.55
10	1.063	0.696		3.27	1.62	
200	1.229	1.30	1.20	2.42	2.06	1.58

TABLE XXV.

Molecular Conductivity

Rubidium Chloride in "62.5 percent" Acetone

V	15°	25°	35°	45°
2	30.9	37.7	44.8	52.8
10	39.0	47.9	57.2	66.7
200	52.5	66.5	82.8	97.4

TABLE XXVI.

Temperature Coefficients

Rubidium Chloride in "62.5 percent" Acetone

	Cond. Units			Percentage		
V	15°-25°	25°-35°	35°-45°	15°-25°	25°-35°	35°-45°
2	0.688	0.710	0.798	2.23	1.88	1.78
10	0.891	0.922	0.955	2.28	1.93	1.67
200	1.20	1.632	1.46	4.37	2.46	1.77

TABLE XXVII.

Molecular Conductivity

Rubidium Chloride in "50 percent" Acetone

V	15°	25°	35°	45°
2	39.1	48.8	59.0	69.8
10	45.6	39.5	70.9	81.8
200	56.7	72.5	90.3	108.6

TABLE XXVIII.

Temperature Coefficients

Rubidium Chloride in "50 percent" Acetone

	Cond. Units			Percentage		
V	15°-25°	25°-35°	35°-45°	15°-25°	25°-35°	35°-45°
2	0.975	1.020	1.077	2.49	2.09	1.82
10	1.388	1.144	1.090	3.04	1.93	1.54
200	1.58	1.78	1.83	2.79	2.45	2.03

TABLE XXIX.

Molecular Conductivity

Rubidium Chloride in "37.5 percent" Acetone

V	15°	25°	35°	45°
2	49.3	61.5	74.8	88.9
10	54.5	69.2	84.4	101.5
200	63.0	82.6	100.1	121.3

TABLE XXX.

Temperature Coefficients

Rubidium Chloride in "37.5 percent" Acetone

	Cond. Units			Percentage		
V	15°-25°	25°-35°	35°-45°	15°-25°	25°-35°	35°-45°
2	1.225	1.325	1.419	2.49	2.16	1.90
10	1.473	1.526	1.708	2.71	2.21	2.03
200	1.952	1.759	2.12	3.10	2.13	2.12

TABLE XXXI.

Molecular Conductivity

Rubidium Chloride in "25 percent" Acetone

V	15°	25°	35°	45°
2	59.0	73.9	89.3	106.0
10	62.8	78.0	93.3	110.0
200	73.6	94.1	116.1	140.0

TABLE XXXII.

Temperature Coefficients

Rubidium Chloride in "25 percent" Acetone

V	Cond. Units			Percentage		
	15°-25°	25°-35°	35°-45°	15°-25°	25°-35°	35°-45°
2	1.495	1.541	1.668	2.54	2.08	1.87
10	1.520	1.532	1.674	2.42	1.97	1.80
200	2.041	2.201	2.39	2.77	2.34	2.06

TABLE XXXIII.

Molecular Conductivity

Rubidium Chloride in "12.5 percent" Acetone

V	15°	25°	35°	45°
2	74.3	91.2	109.4	127.9
10				
200	90.5	115.1	138.4	164.9

TABLE XXXIV.

Temperature Coefficients

Rubidium Chloride in "12.5 percent"Acetone

	Cond. Units			Percentage		
V	15°-25°	25°-35°	35°-45°	15°-25°	25°-35°	35°-45°
2	1.692	1.189	1.850	2.28	2.00	1.69
10						
200	2.46	2.33	2.65	2.72	2.02	1.91

TABLE XXXV.

Specific Conductivity of Water and Acetone Mixtures.
(Multiplied by 10^3)

"%"	15°	25°	35°	45°
12.5	2.59	3.33	4.08	4.92
25.	2.52	3.23	4.02	3.86
37.5	0.94	1.20	1.50	1.82
50.	1.34	1.71	2.09	2.39
62.5	1.13	1.43	1.77	2.12
75.	0.73	0.90	1.08	1.28

TABLE XXXVI.

Molecular Conductivity

Rubidium Nitrate in "75 percent" Acetone

V	15°	25°	35°	45°
4	32.8	39.4	46.4	53.7
10	40.0	48.3	56.9	65.7
50	51.3	62.5	74.1	86.2
100	55.4	67.4	80.7	93.9
200	58.8	71.6	85.3	99.5
400	61.1	74.4	89.0	104.3
800	63.7	79.0	94.2	110.6
1600	67.5	82.2	98.1	115.3

TABLE XXXVII.

Temperature Coefficients

Rubidium Nitrate in "75 percent" Acetone

V	Cond. Units per degree			Percentage		
	15°-25°	25°-35°	35°-45°	15°-25°	25°-35°	35°-45°
4	0.658	0.694	0.74	2.01	1.77	1.60
10	0.827	0.86	0.88	2.07	1.78	1.55
50	1.12	1.16	1.21	2.19	1.86	1.64
100	1.20	1.33	1.32	2.17	1.98	1.64
200	1.28	1.37	1.42	2.18	1.92	1.67
400	1.33	1.46	1.53	2.18	1.96	1.72
800	1.43	1.52	1.64	2.21	1.93	1.74
1600	1.47	1.59	1.72	2.18	1.94	1.75

TABLE XXXVIII.

Molecular Conductivity

Rubidium Nitrate in "62.5 percent" Acetone

V	15°	25°	35°	45°
4	38.8	48.0	57.8	68.1
10	44.3	55.2	66.4	78.2
200	57.1	71.9	87.0	103.8

TABLE XXXIX.

Temperature Coefficients

Rubidium Nitrate in "62.5 percent" Acetone

V	Cond.Units per degree			Percentage		
	15°-25°	25°-35°	35°-45°	15°-25°	25°-35°	35°-45°
4	0.926	0.98	1.03	2.39	2.04	1.78
10	1.09	1.13	1.18	2.47	2.05	1.77
200	1.48	1.51	1.68	2.59	2.09	1.93

TABLE XL.

Molecular Conductivity

Rubidium Nitrate in "50 percent" Acetone

V	15°	25°	35°	45°
2	39.9	50.2	60.9	72.4
4	43.7	55.2	67.3	80.7
10	48.2	61.5	74.8	89.3
50	54.8	69.8	85.8	103.1
100	56.7	72.4	89.1	107.3
200	58.0	75.6	91.9	110.2
400	59.3	75.5	93.1	112.3
800	60.2	77.1	95.0	115.3
1600	59.2	76.2	94.0	113.9

TABLE XLI.

Temperature Coefficients

Rubidium Nitrate in "50 percent" Acetone

	Cond. Units			Percentage		
V	15°-25°	25°-35°	35°-45°	15°-25°	25°-35°	35°-45°
2	1.03	1.07	1.15	2.59	2.13	1.89
4	1.16	1.21	1.34	2.65	2.19	1.99
10	1.33	1.33	1.45	2.76	2.16	1.94
50	1.50	1.60	1.73	2.74	2.29	2.02
100	1.57	1.67	1.82	2.77	2.31	2.04
200	1.76	1.63	1.83	3.02	2.16	1.99
400	1.62	1.76	1.92	2.73	2.33	2.06
800	1.69	1.79	2.03	2.81	2.33	2.14
1600	1.70	1.78	1.99	2.88	2.34	2.12

TABLE XLII.

Molecular Conductivity

Rubidium Nitrate in "37.5 percent" Acetone

V	15°	25°	35°	45°
2	45.7	57.6	70.5	84.7
10	54.4	69.4	84.7	101.4
200	63.9	81.7	101.2	122.0

TABLE XLIII.

Temperature Coefficients

Rubidium Nitrate in "37.5 percent" Acetone

	Cond. Units			Percentage		
V	15°-25°	25°-35°	35°-45°	15°-25°	25°-35°	35°-45°
2	1.19	1.29	1.42	2.61	2.24	2.00
10	1.49	1.53	1.67	2.75	2.21	1.98
200	1.78	1.95	2.08	2.78	2.39	2.05

TABLE XLIV.

Molecular Conductivity

Rubidium Nitrate in "25 percent" Acetone

V	15°	25°	35°	45°
2	54.4	68.3	82.9	98.2
4	58.2	73.5	89.6	106.9
10	61.0	75.1	91.5	110.3
50	69.2	87.8	107.7	128.8
100	71.2	90.6	111.4	133.5
200	73.3	93.5	114.7	137.5
400	73.0	92.9	114.9	137.6
800	79.4	100.4	123.6	147.7
1600	73.3	92.8	114.2	136.6

TABLE XLV.

Temperature Coefficients

Rubidium Nitrate in "25 percent" Acetone

	Cond. Units			Percentage		
V	$15^{\circ}-25^{\circ}$	$25^{\circ}-35^{\circ}$	$35^{\circ}-45^{\circ}$	$15^{\circ}-25^{\circ}$	$25^{\circ}-35^{\circ}$	$35^{\circ}-45^{\circ}$
2	1.40	1.45	1.53	2.57	2.13	1.85
4	1.43	1.61	1.73	2.47	2.19	1.93
10	1.41	1.64	1.88	2.31	2.19	2.06
50	1.86	1.99	2.11	2.69	2.27	1.96
100	1.94	2.08	2.21	2.72	2.30	1.98
200	2.02	2.12	2.28	2.76	2.27	1.99
400	1.99	2.20	2.27	2.73	2.34	1.98
800	2.10	2.32	2.41	2.65	2.31	1.95
1600	1.95	2.14	2.24	2.66	2.31	1.96

TABLE XLVI.

Molecular Conductivity

Rubidium Nitrate in "12.5 percent" Acetone

V	15°	25°	35°	45°
2	65.1	80.6	96.8	113.7
10	74.1	91.7	106.9	123.9
200	87.0	108.8	131.7	156.4

TABLE XLVII.

Temperature Coefficients

Rubidium Nitrate in "12.5 percent" Acetone

	Cond. Units			Percentage		
V	15°-25°	25°-35°	35°-45°	15°-25°	25°-35°	35°-45°
2	1.55	1.62	1.69	2.38	2.00	1.75
10	1.76	1.51	1.71	2.37	1.65	1.60
200	2.18	2.29	2.47	2.50	2.10	1.88

TABLE XLVIII.

Viscosity and Fluidity of Rubidium Iodide in 75 percent Acetone with water.

Mol. Conc.	η 15°	η 25°	η 35°	η 45°
1.00	0.01338	0.01087	0.00912	0.00751
0.75	0.01276	0.01027	0.00818	0.00702
0.50	0.01219	0.00974	0.00796	0.00664
0.25	0.01169	0.00936	0.00761	0.00633
0.10	0.01147	0.00918	0.00747	0.00620
Solv.	0.01119	0.00896	0.00728	0.00605

Mol. Conc.	φ 15°	φ 25°	φ 35°	φ 45°
1.00	74.74	91.97	109.7	133.2
0.75	78.36	97.38	122.3	142.4
0.50	82.06	102.7	125.7	150.7
0.25	85.51	106.9	131.3	158.0
0.10	87.20	108.9	133.9	161.3
Solv.	89.37	111.6	137.3	165.4

TABLE XLIX.

Viscosity and Fluidity of Rubidium Iodide in 62.5 percent Acetone with water.

Mol. Conc.	η 15°	η 25°	η 35°	η 45°
0.50	0.01554	0.01195	0.00948	0.00774
0.10	0.01541	0.01182	0.00932	0.00758
Solv.	0.01509	0.01177	0.00914	0.00743

Mol. Conc.	φ 15°	φ 25°	φ 35°	φ 45°
0.50	64.34	83.72	105.5	129.1
0.10	64.91	84.60	107.3	131.9
Solv.	66.28	84.94	109.4	134.7

TABLE L.

Viscosity and Fluidity of Rubidium Iodide in 50 percent Acetone with water.

Mol. Conc.	$\eta\ 15^{\circ}$	$\eta\ 25^{\circ}$	$\eta\ 35^{\circ}$	$\eta\ 45^{\circ}$
1.00	0.02007	0.01623	0.01172	0.00938
0.75	0.01822	0.01362	0.01053	0.00842
0.50	0.01717	0.01334	0.01023	0.00824
0.25	0.01554	0.01178	0.00930	0.00749
0.10	0.01491	0.01149	0.00909	0.00743
Solv.	0.01779	0.01332	0.01028	0.00820

Mol. Conc.	$\varphi\ 15^{\circ}$	$\varphi\ 25^{\circ}$	$\varphi\ 35^{\circ}$	$\varphi\ 45^{\circ}$
1.00	49.82	61.62	85.32	106.6
0.75	54.89	73.40	94.96	118.7
0.50	58.29	74.96	97.74	121.3
0.25	64.36	84.90	107.5	133.5
0.10	67.06	87.01	110.0	134.5
Solv.	56.21	75.06	97.29	122.0

TABLE LI.

Viscosity and Fluidity of Rubidium Iodide in 37.5 percent Acetone with water.

Mol. Conc.	$\eta\ 15^{\circ}$	$\eta\ 25o$	$\eta\ 35^{\circ}$	$\eta\ 45^{\circ}$
0.50	0.01711	0.01044	0.01017	0.00810
0.10	0.01819	0.01356	0.01046	0.00830
Solv.	0.01836	0.01365	0.01037	0.00822

Mol. Conc.	$\varphi\ 15^{\circ}$	$\varphi\ 25^{\circ}$	$\varphi\ 35^{\circ}$	$\varphi\ 45^{\circ}$
0.50	58.44	95.78	98.29	123.5
0.10	54.96	73.76	95.56	120.5
Solv.	54.46	73.27	96.43	121.7

TABLE LII.

Viscosity and Fluidity of Rubidium Iodide
in 25 percent Acetone with water.

Mol. Conc.	$\eta\ 15^{\circ}$	$\eta\ 25^{\circ}$	$\eta\ 35^{\circ}$	$\eta\ 45^{\circ}$
1.00	0.01500	0.01156	0.00925	0.00761
0.75	0.01553	0.01196	(0.00952)	(0.00839)
0.50	0.01597	0.01214	0.00937	0.00870
0.25	0.01626	0.01218	0.00951	0.00767
0.10	0.01677	0.01261	0.00977	0.00787
Solv.	0.01714	0.01275	0.00883	0.00788

Mol. Conc.	$\varphi\ 15^{\circ}$	$\varphi\ 25^{\circ}$	$\varphi\ 35^{\circ}$	$\varphi\ 45^{\circ}$
1.00	66.66	86.48	108.2	131.4
0.75	64.39	83.65		
0.50	62.60	82.35		
0.25	61.50	82.10	105.2	130.3
0.10	58.62	79.28	102.3	127.1
Solv.	58.33	78.42	101.7	126.9

TABLE LIII.

Viscosity and Fluidity of Rubidium Iodide
in 12.5 percent Acetone with water.

Mol. Conc.	$\eta\ 15^{\circ}$	$\eta 25^{\circ}$	$\eta 35^{\circ}$	$\eta 45^{\circ}$
0.50	0.01334	0.01034	0.00829	0.00678
0.10	0.01415	0.01085	0.00854	0.00697
Solv.	0.01442	0.01089	0.00862	0.00700

Mol. Conc.	$\varphi 15^{\circ}$	$\varphi\ 25^{\circ}$	$\varphi 35^{\circ}$	$\varphi 45^{\circ}$
0.50	74.95	96.70	120.6	147.4
0.10	70.68	92.20	117.0	143.5
Solv.	69.37	91.83	116.1	142.9

TABLE LIV.

Viscosity and Fluidity of Rubidium Bromide in 75 percent Acetone with Water.

Mol. Conc.	η 15°	η 25°	η 35°	η 45°
0.50	0.01204	0.00963	0.00794	0.00667
0.25	0.01162	0.00925	0.00758	0.00639
Solv.	0.01114	0.00886	0.00721	0.00599

Mol. Conc.	φ 15°	φ 25°	φ 35°	φ 45°
0.50	83.07	103.9	126.0	149.9
0.25	86.06	108.1	131.9	156.5
Solv.	89.76	112.8	138.6	166.9

TABLE LV.

Viscosity and Fluidity of Rubidium Bromide in 62.5 percent Acetone with water.

Mol. Conc.	η 15°	η 25°	η 35°	η 45°
0.50	0.01556	0.01200	0.00951	0.00774
0.10	0.01547	0.01186	0.00936	0.00757
Solv.	0.01516	0.01158	0.00910	0.00731

Mol. Conc.	φ 15°	φ 25°	φ 35°	φ 45°
0.50	64.26	83.31	105.2	129.2
0.10	64.64	84.29	106.8	132.1
Solv.	65.99	86.37	109.9	136.8

TABLE LVI.

Viscosity and Fluidity of Rubidium Bromide in 50 percent Acetone with water.

Mol. Conc.	η 15°	η 25°	η 35°	η 45°
1.00	0.01772	0.01347	0.01060	0.00859
0.75	0.01781	0.01358	0.01119	0.00861
0.50	0.01778	0.01358	0.01061	0.00853
0.25	0.01774	0.01331	0.01038	0.00845
0.10	0.01774	0.01331	0.01039	0.00819
Solv.	0.01774	0.01329	0.01026	0.00818

Mol. Conc.	φ 15°	φ 25°	φ 35°	φ 45°
1.00	56.44	74.26	94.30	116.4
0.75	56.15	73.63	89.40	116.2
0.50	56.25	73.91	94.24	117.2
0.25	56.38	75.16	96.30	118.3
0.10	56.37	75.14	96.27	122.1
Solv.	56.37	75.14	96.49	122.2

TABLE LVII.

Viscosity and Fluidity of Rubidium Bromide in 37.5 percent Acetone with water.

Mol. Conc.	η 15°	η 25°	η 35°	η 45o
0.50	0.01780	0.01331	0.01028	0.00818
0.10	0.01823	0.01354	0.01038	0.00823
Solv.	0.01829	0.01361	0.01050	0.00827

Mol. Conc.	φ 15°	φ 25°	φ 35°	φ 45°
0.50	56.19	75.13	97.24	122.2
0.10	54.86	73.87	96.34	121.5
Solv.	54.69	73.46	95.43	120.9

TABLE LVIII.

Viscosity and Fluidity of Rubidium Bromide in 25 percent Acetone with water.

Mol. Conc.	$\eta\,15^{\circ}$	$\eta\,25^{\circ}$	$\eta\,35^{\circ}$	$\eta\,45^{\circ}$
0.50	0.01630	0.01247	0.00978	0.00780
0.25	0.01642	0.01228	0.00954	0.00767
0.10	0.01658	0.01227	0.00950	0.00757
Solv.	0.01699	0.01266	0.00975	0.00779

Mol. Conc.	$\varphi\,15^{\circ}$	$\varphi\,25^{\circ}$	$\varphi\,35^{\circ}$	$\varphi\,45^{\circ}$
0.50	61.33	80.17	102.3	126.6
0.25	60.89	81.49	104.9	130.3
0.10	60.31	81.52	105.2	132.2
Solv.	59.05	79.01	102.6	128.3

TABLE LIX.

Viscosity and Fluidity of Rubidium Bromide in 12.5 percent Acetone with water.

Mol. Conc.	$\eta\,15^{\circ}$	$\eta\,25^{\circ}$	$\eta\,35^{\circ}$	$\eta\,45^{\circ}$
0.50	0.01367	0.01065	0.00847	0.00695
0.10	0.01415	0.01086	0.00852	0.00698
Solv.	0.01430	0.01086	0.00855	0.00698

Mol. Conc.	$\varphi\,15^{\circ}$	$\varphi\,25^{\circ}$	$\varphi\,35^{\circ}$	$\varphi\,45^{\circ}$
0.50	73.14	93.87	118.1	143.9
0.10	70.65	92.09	117.4	143.3
Solv.	69.91	92.05	116.9	143.4

TABLE LX.

Viscosity and Fluidity of Rubidium Chloride in 75 percent Acetone with water

Mol. Conc.	η 15°	η 25°	η 35°	η 45°
0.50	See note			
0.25	0.01157	0.00927	0.00756	0.00628
0.10	0.01137	0.00910	0.00742	0.00615
Solv.	0.01116	0.00891	0.00725	0.00602

Mol. Conc.	φ 15°	φ 25°	φ 35°	φ 45°
0.50	See note			
0.25	86.38	107.9	132.2	159.2
0.10	87.95	109.9	134.7	162.6
Solv.	89.61	112.2	137.9	166.0

TABLE LXI.

Viscosity and Fluidity of Rubidium Chloride in 62.5 percent Acetone with water

Molv. Conc.	η 15°	η 25°	η 35°	η 45°
0.50	0.01568	0.01212	0.00967	0.00794
0.10	0.01526	0.01174	0.00916	0.00745
Solv.	0.01514	0.01177	0.00912	0.00738

Mol. Conc.	φ 15°	φ 25°	φ 35°	φ 45°
0.50	63.78	82.50	103.4	125.9
0.10	65.50	85.17	109.2	134.2
Solv.	66.05	85.96	109.6	135.5

TABLE LXII.

Viscosity and Fluidity of Rubidium Chloride in 50 percent Acetone with water

Mol. Conc.	$\eta\,15^{\circ}$	$\eta\,25^{\circ}$	$\eta\,35^{\circ}$	$\eta\,45^{\circ}$
0.50	0.01774	0.01336	0.01037	0.00832
0.10	0.01778	0.01322	0.01030	0.00818
Solv.	0.01774	0.01729	0.01026	0.00818

Mol. Conc.	$\varphi\,15^{\circ}$	$\varphi\,25^{\circ}$	$\varphi\,35^{\circ}$	$\varphi\,45^{\circ}$
0.50	56.36	74.85	96.43	120.3
0.10	56.24	75.65	97.13	122.2
Solv.	56.37	75.14	96.49	122.2

TABLE LXIII.

Viscosity and Fluidity of Rubidium Chloride in 37.5 percent Acetone with water.

Mol. Conc.	$\eta\,15^{\circ}$	$\eta\,25^{\circ}$	$\eta\,35^{\circ}$	$\eta\,45^{\circ}$
0.50	0.01933	0.01376	0.01071	0.00857
0.10	0.01820	0.01354	0.01044	0.00829
Solv.	0.01825	0.01364	0.01036	0.00825

Mol. Conc.	$\varphi\,15^{\circ}$	$\varphi\,25^{\circ}$	$\varphi\,35^{\circ}$	$\varphi\,45^{\circ}$
0.50	51.74	72.69	93.34	116.7
0.10	54.93	73.83	95.78	120.6
Solv.	54.80	73.31	96.42	121.2

TABLE LXIV.

Viscosity and Fluidity of Rubidium Nitrate

in 75 percent Acetone with water.

Mol. Conc.	η 15°	η 25°	η 35°	η 45°
0.25	0.01155	0.00920	0.00753	0.00625
0.10	0.01136	0.00910	0.00741	0.00617
Solv.	0.01132	0.00889	0.00725	0.00602

Mol. Conc.	φ 15°	φ 25°	φ 35°	φ 45°
0.25	86.54	108.6	132.8	159.9
0.10	88.01	109.8	135.0	162.1
Solv.	89.83	112.4	137.8	166.2

TABLE LXV.

Viscosity and Fluidity of Rubidium Nitrate

in 62.5 percent Acetone with water.

Mol. Conc.	η 15°	η 25°	η 35°	η 45°
0.50	0.01562	0.01216	0.00962	0.00787
0.25	0.01496	0.01163	0.00920	0.00742
0.10		0.01159	0.00909	0.00737
Solv.	0.01516	0.01195	0.00914	0.00740

Mol. Conc.	φ 15°	φ 25°	φ 35°	φ 45°
0.50	64.04	82.24	103.9	127.0
0.25	66.83	86.01	108.7	134.8
0.10		86.29	110.0	135.6
Solv.	65.97	83.66	109.4	135.0

TABLE LXVI.

Viscosity and Fluidity of Rubidium Nitrate in 50 percent Acetone with water.

Mol. Conc.	$\eta\ 15^{\circ}$	$\eta\ 25^{\circ}$	$\eta\ 35^{\circ}$	$\eta\ 45^{\circ}$
0.50	0.01820	0.01373	0.01068	0.00858
0.25	(0.01714)	0.01301	0.01018	0.00824
0.10	0.01761	0.01308	0.01007	0.00801
Solv.	0.01769	0.01325	0.01022	0.00815

Mol. Conc.	$\varphi\ 15^{\circ}$	$\varphi\ 25^{\circ}$	$\varphi\ 35^{\circ}$	$\varphi\ 45^{\circ}$
0.50	54.94	77.83	93.63	116.6
0.25			98.23	121.4
0.10	56.79	76.45	99.30	124.8
Solv.	56.53	75.47	97.85	122.7

TABLE LXVII.

Viscosity and Fluidity of Rubidium Nitrate in 37.5 percent Acetone with water.

Mol. Conc.	$\eta\ 15^{\circ}$	$\eta\ 25^{\circ}$	$\eta\ 35^{\circ}$	$\eta\ 45^{\circ}$
0.50	0.01781	0.01344	0.01049	0.00845
0.10	0.01814	0.01349	0.01042	0.00830
Solv.	0.01810	0.01359	0.01021	0.00830

Mol. Conc.	$\varphi\ 15^{\circ}$	$\varphi\ 25^{\circ}$	$\varphi\ 35^{\circ}$	$\varphi\ 45^{\circ}$
0.50	56.15	74.42	95.32	118.3
0.10	55.11	74.15	95.97	120.5
Solv.	55.25	72.02	97.96	125.0

TABLE LXVIII.

Viscosity and Fluidity of Rubidium Nitrate in 25 percent Acetone with water.

Mol. Conc.	$\eta 15^0$	$\eta 25^0$	$\eta 35^0$	$\eta 45^0$
0.50	0.01602	0.01224	0.00959	0.00777
0.25	0.01661	0.01252	0.00977	0.00781
Solv.	0.01696	0.01268	0.00981	0.00782

Mol. Conc.	$\varphi 15^0$	$\varphi 25^0$	$\varphi 35^0$	$\varphi 45^0$
0.50	62.42	81.70	104.3	128.7
0.25	60.21	79.87	102.4	128.0
Solv.	58.96	78.86	101.9	127.9

TABLE LXIX.

Viscosity and Fluidity of Rubidium Nitrate in 12.5 percent Acetone with water.

Mol. Conc.	$\eta 15^0$	$\eta 25^0$	$\eta 35^0$	$\eta 45^0$
0.50	0.01364	0.01060	0.00847	0.00695
0.10	0.01398	0.01080	0.00849	0.00689
Solv.	0.01420	0.01079	0.00844	0.00689

Mol. Conc.	$\varphi 15^0$	$\varphi 25^0$	$\varphi 35^0$	$\varphi 45^0$
0.50	71.76	94.31	118.0	140.9
0.10	70.42	92.66	117.8	145.1
Solv.	70.42	92.66	126.3	145.0

TABLE LXX.

Comparison of the Viscosities and Fluidities of Rubidium Bromide in Acetone--Water Mixtures.

		75 percent		6.25 percent		50 percent	
		η	φ	η	φ	η	φ
15°	2	0.01204	83.07	0.01556	64.26	0.01778	56.25
	10			0.01547	64.64	0.01774	56.37
	S.	0.01115	89.76	0.01516	65.99	0.01774	56.37
25°	2	0.00963	103.9	0.01200	83.31	0.01353	73.91
	10			0.01186	84.29	0.01331	75.14
	S.	0.00886	112.8	0.01158	86.37	0.01329	75.14
35°	2	0.00794	125.0	0.00951	105.2	0.01061	94.25
	10			0.00936	106.8	0.01039	96.26
	S.	0.00721	138.6	0.00910	109.9	0.01026	96.49
45°	2	0.00667	149.9	0.00774	129.2	0.00853	117.2
	10			0.00757	132.1	0.00819	122.1
	S.	0.00599	166.9	0.00731	136.8	0.00818	122.2

		37.5 percent		25 percent	
		η	φ	η	φ
15°	2	0.01780	56.19	0.01630	61.33
	10	0.01823	54.86	0.01658	60.31
	S.	0.01829	54.69	0.0	59.05
25°	2	0.01331	75.13	0.01247	80.17
	10	0.01354	73.87	0.01227	81.52
	S.	0.01361	73.46	0.01266	79.01
35°	2	0.01028	97.24	0.00978	102.3
	10	0.01038	96.34	0.00950	105.2
	S.	0.01050	95.93	0.00975	102.6
45°	2	0.00818	122.2	0.00790	126.6
	10	0.00823	121.5	0.00756	132.1
	S.	0.00827	120.9	0.00779	128.3

TABLE LXX (Continued).

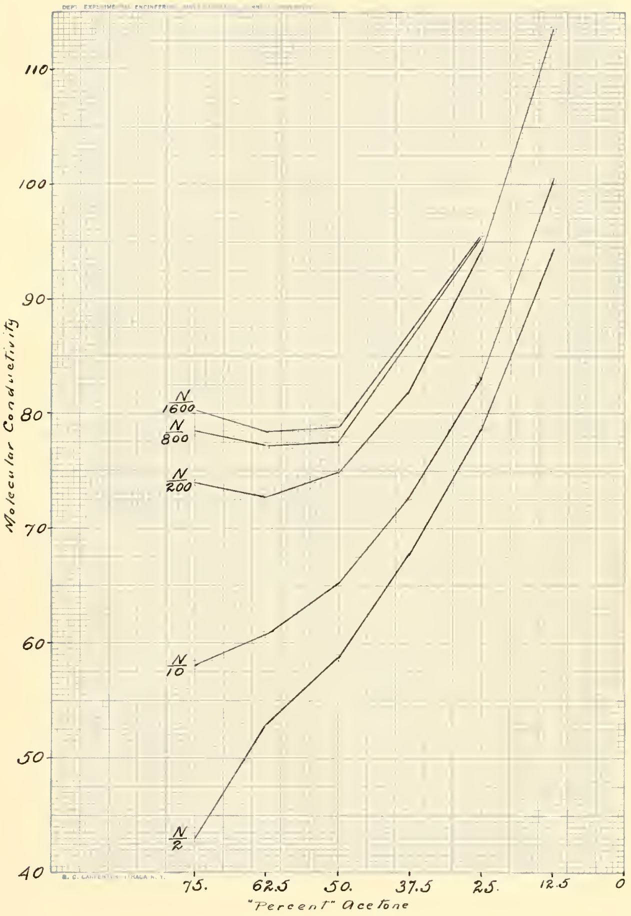
Comparison of the Viscosities and Fluidities of Rubidium Bromide in Acetone--Water Mixtures.

		12.5 percent		0 percent	
		η	φ	η	φ
15°	2	0.01367	73.14		
	10	0.01415	70.65		
	S.	0.01430	69.91		
25°	2	0.01005	93.87	0.00872	114.7
	10	0.01086	92.09	0.00880	113.6
	S.	0.01086	92.05	0.00891	112.2
35°	2	0.00847	118.1	0.00718	139.4
	10	0.00852	117.4	0.00717	139.4
	S.	0.00855	116.9	0.00720	138.9
45°	2	0.00695	143.9	0.00608	164.3
	10	0.00698	143.3	0.00596	167.7
	S.	0.00698	143.3	0.00597	167.5

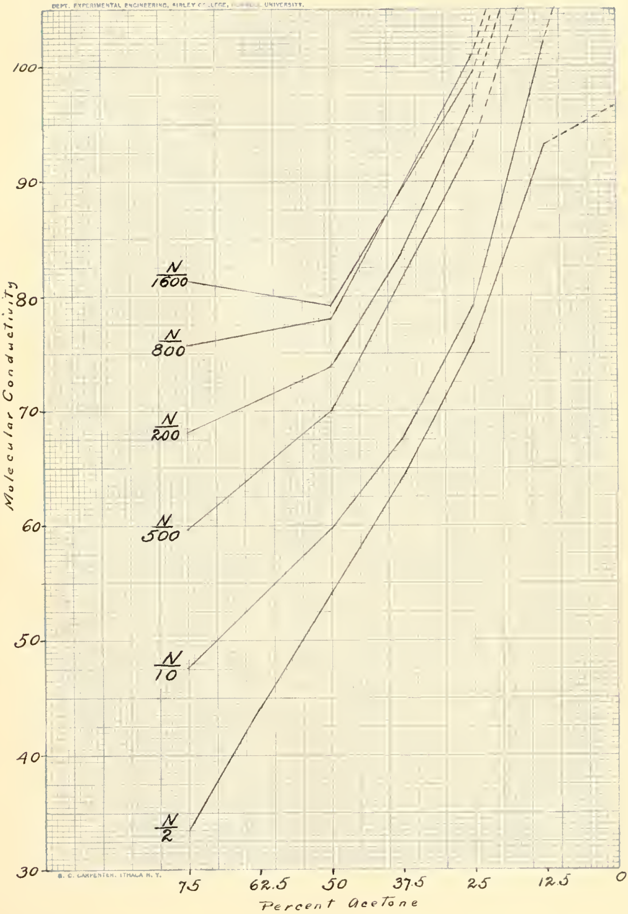
TABLE LXXI.

Comparison of Temperature Coefficients of Fluidity of Rubidium Bromide in Acetone--Water.

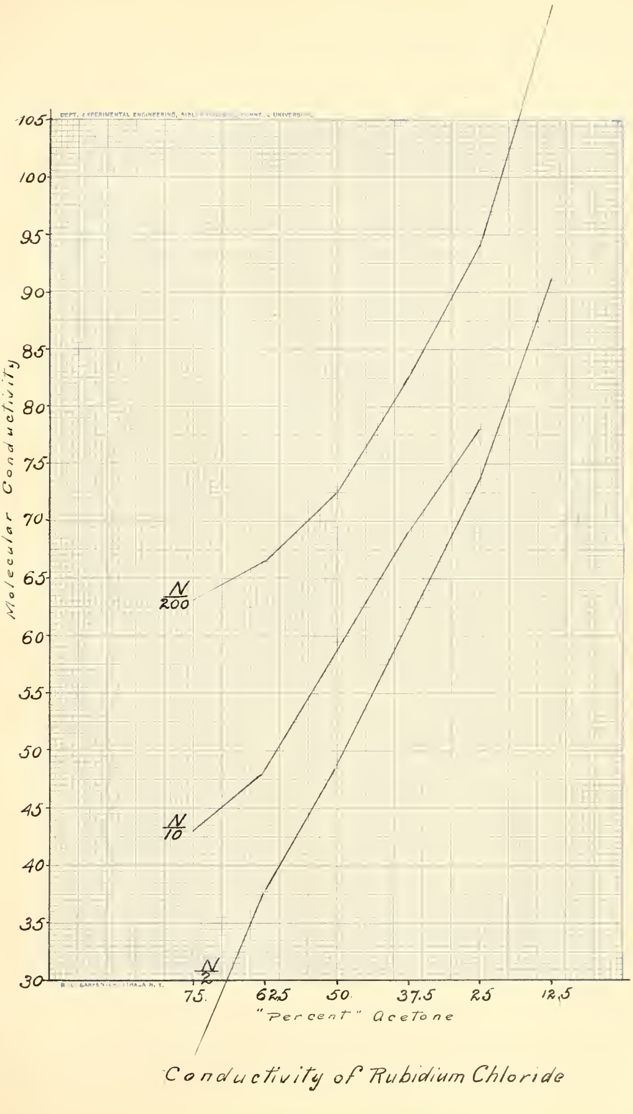
	75 percent			25 percent		
	15°-25°	25°-35°	35°-45°	15°-25°	25°-35°	35°-45°
2	0.0251	0.0212	0.0189	0.0307	0.0276	0.0238
4	0.0256	0.0220	0.0187	0.0337	0.0287	0.0243
10	0.0244	0.0225	0.0200	0.0330	0.0291	0.0256
Solv.	0.0257	0.0229	0.0201	0.0338	0.0299	0.0250



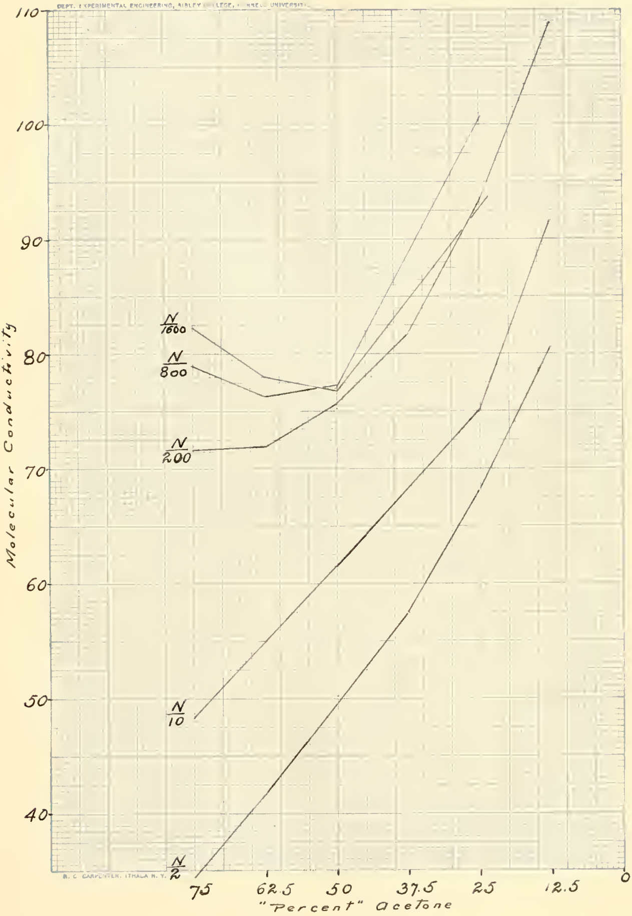
Conductivity of Rubidium Iodide in Acetone-Water at 25°



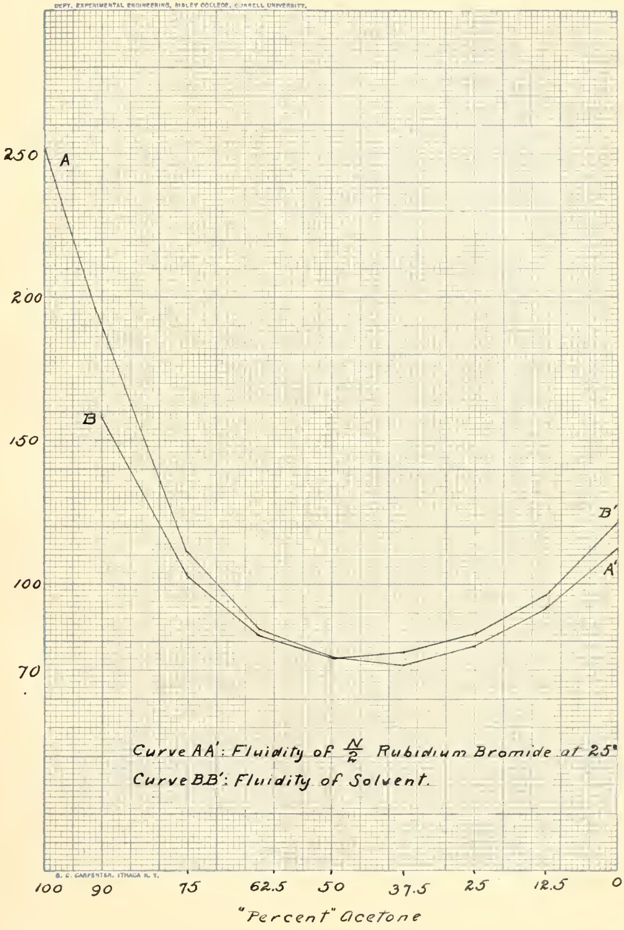
Conductivity of Rubidium Bromide in Acetone-Water at 25°



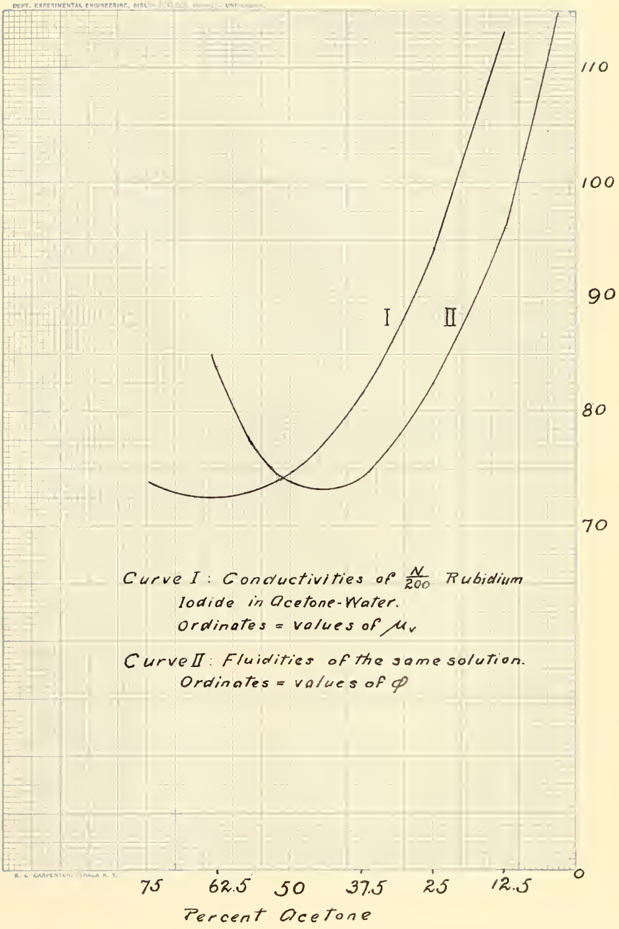
Conductivity of Rubidium Chloride



Conductivity of Rubidium Nitrate at 25°



Comparison of Fluidities of Rubidium Bromide Solution and Solvent.



Curve I: Conductivities of $\frac{N}{200}$ Rubidium Iodide in Acetone-Water.
Ordinates = values of μ_v

Curve II: Fluidities of the same solution.
Ordinates = values of ϕ

DISCUSSION.

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It was found by Jones and Veazey[1] that the curves expressing the fluidity of varying mixtures of acetone and water are almost exactly parallel to those for the conductivity of potassium sulphocyanate in solution in the same mixtures. The fluidity curve for acetone has a minimum between 37.5 percent and 50 percent; and the fluidity for the rubidium halides and nitrate has its minimum in approximately the same position. The conductivity curves, however, of the rubidium salts have their minima corresponding to a much greater percentage of acetone. As has been shown by previous workers, this minimum in fluidity occurs at the position where the breaking down of association of one solvent by the other is greatest. The conductivity depends upon the velocities of the ions and the degree of dissociation. The dissociation is least when the association of the solvent is least, and the speed of the ions is least when the fluidity is greatest. Therefore, if these were the only determining factors, the conductivity minima would always correspond to the fluidity minima.

Potassium sulphocyanate has a considerable solubility in pure acetone (about 20 grams in 100 grams of acetone at 20°), whereas the rubidium salts studied are only slightly soluble in pure acetone. Therefore in the same concentrations, the rubi-

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[1] Amer. Chem. Journ., 37, 405 (1907).

dium salts are nearer saturation than potassium sulphocyanate. The percentage dissociation is, therefore, lower in the case of rubidium salts than in that of potassium sulphocyanate. A possible explanation of shifting of the minimum in the conductivity of rubidium salts, towards the greater proportions of acetone, is that the great insolubility in acetone might cause the dissociation to be driven back. This shifting of the minimum by the slight solubility, however, does not seem to be a simple relation. It is clearly manifested only between salts with great difference in solubility in acetone; as is the case of potassium sulphocyanate and the rubidium halides. Differences in solubility in water of the different rubidium salts do not show any such effect, possibly because in the dilutions which are sufficiently great to show any minimum at all, they are too far from saturation.

Of the four salts, rubidium iodide, chloride, bromide and nitrate, the minima are farthest from the acetone side of the plate for the iodide and the nitrate, which are, respectively, the most soluble and the least soluble in water. The solubility of these salts in acetone is not acceptably known, except that of the iodide, which is probably the most soluble of the four. In the dilutions greater than $\frac{N}{800}$, that is, where the dissociation approaches completeness, the minima in the conductivity curves are seen to be nearer those of the fluidity.

A comparison of the percentage coefficients of fluidity given in Table LXXI with those of conductivity, shows that

the two are nearly equal, which is to be expected in the case of a non-solvated salt. For the same salt the coefficients for conductivity, while nearly equal, are somewhat smaller than those for fluidity. As Davis and Jones have pointed out, this is due to "the decrease in association of the solvent with rise in temperature, causing a decrease in the ionization of the solute, and therefore a smaller conductivity."

In most cases the molecular conductivities of $\frac{N}{800}$ and $\frac{N}{1600}$ are practically the same, showing that the dissociation has apparently become nearly constant. This does not indicate that the salt is anywhere near complete dissociation. If the conductivity depends only upon the velocity of the ions and the number of ions present, then, in the case of a non-hydrated electrolyte, since velocity is proportional to fluidity,

$$\frac{\mu_\infty \text{ in solvent}}{\mu_\infty \text{ in water}} = \frac{\varphi \text{ of solvent}}{\varphi \text{ of water}}$$

This would indicate a value of μ_∞ = 102. for rubidium bromide at 25° in "fifty percent" acetone. The molecular conductivity becomes constant at about 80. indicating an equilibrium between molecules and ions at α = 78 percent., α being the percentage dissociation.

SUMMARY.

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1. Minima in the conductivity curves for rubidium salts correspond to a higher percentage of acetone in the solvent mixtures, than do those in the fluidity curves, whereas the two curves are parallel for certain other salts. A possible explanation based on the difference in solubility is offered.

2. A comparison of the temperature coefficients of conductivity and fluidity shows that these are what is to be expected in the case of a non-solvated salt in a mixture of associated solvents.

3. A possible indication of the percentage dissociation of the salts in the solutions studied has been pointed out.

BIOGRAPHY.

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The author of this dissertation was born in Charleston, South Carolina, October 20, 1885. He received the degree of Bachelor of Science from the College of Charleston in 1905, and that of Master of Arts in 1906. In November, 1911, he entered the Johns Hopkins University as a graduate student in Chemistry. His subordinate studies were Physical Chemistry and Geology.